NATIONAL REPORT OF AOTEAROA NEW ZEALAND

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concretenz LEARNED SOCIETY

fib CEB-FIP Aotearoa New Zealand

7th fib Congress Lisbon - 2026

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Lisbon - 2026

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Inside front cover. *Te Whare o Rehua Sarjeant Gallery, Whanganui.*

Projects 2, 3, 5, 6, 8, 9 & 10 were entries in Concrete NZ's Conference Awards or Concrete Construction Awards.

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NATIONAL REPORT OF AOTEAROA NEW ZEALAND

This National Report of Aotearoa New Zealand has been prepared for the Seventh International *fib* Congress in Lisbon, Portugal. It provides a snapshot of contemporary structural concrete practice through a selection of recently completed building and infrastructure projects, highlighting how design and construction respond to New Zealand's environmental, cultural and regulatory context.

New Zealand's geographically isolated and seismically active setting, combined with exposure to marine, alpine, geothermal and remote rural environments, places strong emphasis on earthquake resilience, durability and whole-of-life performance. At the same time, increasing focus is being placed on sustainability, constructability and the integration of structures within their physical and cultural landscapes. Together, these factors shape an approach that prioritises robustness, adaptability and long-term value.

The projects presented reflect these priorities in current practice. Low-damage seismic design is prominent, particularly in urban buildings where rapid post-earthquake functionality and repairability are critical. In infrastructure and coastal works, durability in aggressive environments governs material selection, detailing and construction methodology. Across all sectors, performance-based design enables tailored responses to complex site conditions while meeting demanding serviceability and resilience requirements.

Cultural context is also central. Reflecting the broader emphasis on integration with physical and cultural landscapes, many projects are informed by Māori values and narratives, influencing architectural expression and material selection. Concrete is frequently chosen for its ability to deliver not only strength, durability and thermal performance, but also express permanence and form in ways that respond to landscape and cultural identity.

This report presents a representative cross-section of projects rather than a comprehensive survey, spanning heritage strengthening, civic buildings and major infrastructure. Prepared under the auspices of the Concrete NZ Learned Society, it is offered to *fib* Congress delegates as a contribution to international knowledge exchange.

welcome

On behalf of the Concrete NZ Learned Society, it is my pleasure to present the National Report of Aotearoa New Zealand to delegates of the Seventh International *fib* Congress in Lisbon, Portugal.

National Reports are a valued part of *fib* Congresses, offering member countries an opportunity to share current practice and highlight how structural concrete is designed and delivered in response to local conditions, cultural context, regulatory environments and emerging technical challenges. This report presents a selection of New Zealand projects demonstrating the application of structural concrete across a range of building and infrastructure typologies, reflecting both technical innovation and location-responsive design.

The Concrete NZ Learned Society has been a long-standing member of *fib* and values its role in connecting professionals, advancing technical knowledge, and supporting the international exchange of research and best practice. *fib*'s technical commissions, publications and events continue to inform New Zealand practice, particularly in areas such as seismic resilience, durability and sustainability.

A further strength of *fib* lies in its ability to convene the global concrete community through symposia and congresses. In 2024, the Concrete NZ Learned Society had the privilege of hosting the *fib* Symposium in Christchurch, bringing together researchers and practitioners from around the world and showcasing New Zealand's approach to structural design in a seismically active and environmentally demanding context. We remain grateful to all who contributed to its success.

As *fib* gathers again in Lisbon, we extend our best wishes to the hosts and organising committee for a successful and stimulating event. We hope this report provides useful insight into New Zealand practice and contributes to the ongoing exchange of knowledge at the heart of fib's mission.

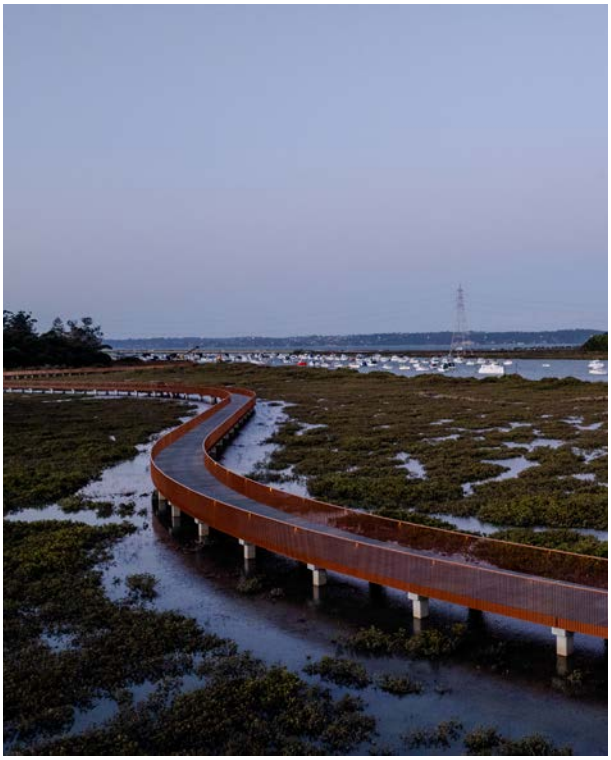
Moustafa Al-Ani
PRESIDENT, CONCRETE NZ LEARNED SOCIETY

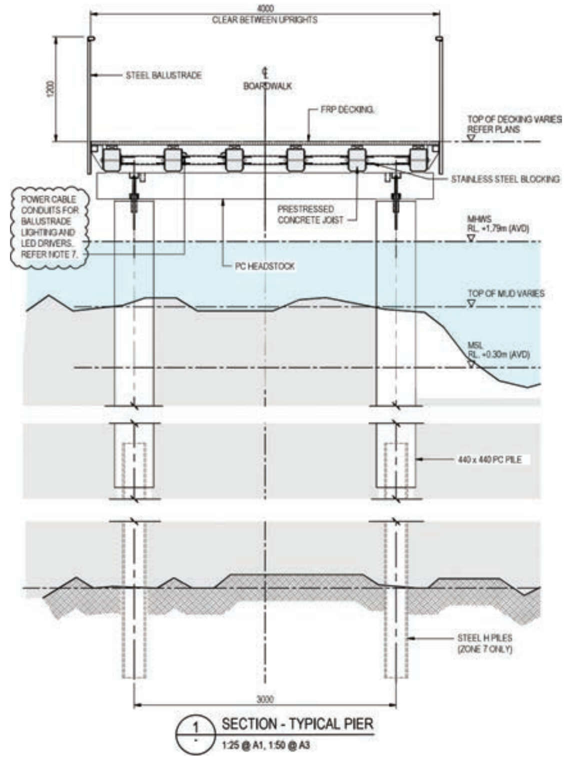
Te Whau Pathway Boardwalk

PROJECT OVERVIEW

The Te Whau Pathway is a major shared-use infrastructure project in Auckland, connecting communities along the Whau River while responding to a highly sensitive coastal environment. When complete, the 15 km pathway will link the Waitematā and Manukau Harbours along a historic portage route used by mana whenua, embedding cultural and environmental narratives within a contemporary public asset.

A key component is Section 5, which includes a 1.1 km elevated boardwalk traversing extensive mangrove habitats. Delivered by Auckland Council, with design by Beca and construction by HEB Construction, the project demonstrates how modular precast concrete systems can support low-impact construction in challenging marine environments.





The project was shaped by a strong collaborative framework involving Auckland Council, local boards, community stakeholders, and mana whenua including Te Kawerau a Maki and Ngāti Whātua Ōrākei. Delivery through an Early Contractor Involvement (ECI) model enabled the team to respond to evolving design, procurement and environmental constraints. During the COVID-19 pandemic, supply chain pressures prompted a transition from an aluminium superstructure to a precast concrete solution, improving durability and reducing procurement risk.

Concrete and structural approach

The boardwalk adopts a highly modular, simply supported structural system designed for repeatability and efficient assembly. Each span comprises six precast prestressed concrete joists forming a grillage system, supported on precast headstocks founded on paired piles. Stainless-steel transverse blockings provide connectivity, while Fibre Reinforced Plastic (FRP grating panels form the deck surface. Modular balustrade panels are installed in discrete segments, enabling future replacement without major intervention.

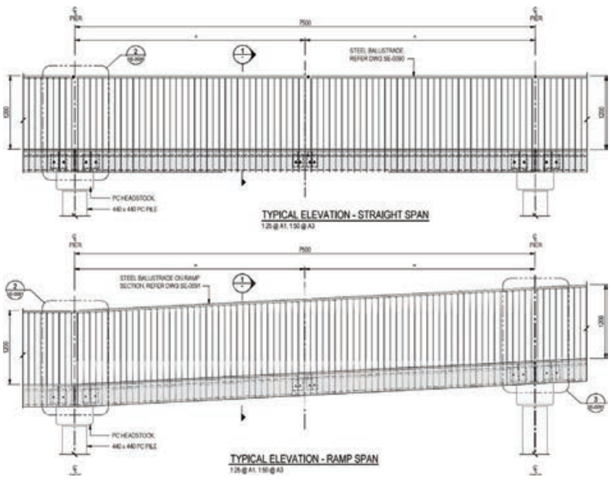
The alignment incorporates both straight and curved spans to accommodate site geometry, tidal constraints, and clearance requirements. Structural design addressed a range of loading conditions, including pedestrian and maintenance loads, seismic actions, and wave loading. Seismic design was undertaken in accordance with NZS 1170.5, with soil–structure interaction explicitly modelled to account for variable ground conditions.

Wave loading, combined with extreme water levels and projected sea-level rise, governed the design of the pile system and lateral resistance. Pile solutions were adapted to suit ground variability, combining driven steel sections with precast concrete segments in softer soils and bored or in-situ piles where rock was shallow.

Durability considerations were central to the design. Prestressed concrete joists were detailed to meet marine exposure requirements, with stainless-steel fixings and high-quality finishes specified to reduce corrosion risk. Headstock-to-pile connections were designed to accommodate rotation and resist wave and seismic actions while protecting reinforcement in an aggressive environment.

Construction and verification

Construction methodology was closely aligned with the modular design philosophy and the need to minimise environmental disturbance. A "build-over-the-top" approach was adopted, enabling construction to



proceed from temporary staging and then from the completed structure itself, avoiding ground-based access within the mangrove habitat.

Piling works established the permanent substructure, allowing a gantry system to be installed for the placement of precast elements from above. This approach eliminated the need for extensive temporary works and reduced ecological impact. Precast pre-stressed joists were manufactured off-site at a specialist facility, while piles and headstocks were produced locally in a dedicated precast yard, improving quality control and reducing transport requirements.

Digital delivery tools were integral to construction and verification. Each precast element was uniquely identified and tracked through production, curing, transport, installation and inspection. 3D modelling and cloud-based quality assurance systems enabled real-time verification of installation accuracy, reduced errors, and provided transparent monitoring of construction progress.

Outcomes and significance

The Te Whau Pathway boardwalk demonstrates how modular precast concrete systems can deliver durable, efficient, and low-impact infrastructure within ecologically sensitive environments. The build-over-the-top construction methodology significantly reduced disturbance to mangrove habitats, while off-site prefabrication improved material efficiency and reduced waste.

The project also highlights the value of early collaboration and digital delivery in achieving high-quality outcomes under complex environmental and logistical constraints. Durability-driven detailing and material selection ensure long-term performance in a Class C marine environment, while modular design supports future maintenance and adaptability.

Completed between SH16 and Roberts Road, the boardwalk provides a high-quality public asset that balances technical performance with environmental and cultural responsiveness. The approach offers a replicable model for future stages of the pathway and for similar coastal infrastructure projects across New Zealand.

Reference: Xu, J., Dickson, A., O'Donnell, A. and Caudwell, E. (2025). *Te Whau Pathway Project: Modular Precast Design for Low-Impact Construction in an Ecologically Sensitive Marine Environment.* Concrete NZ Conference, Auckland, New Zealand.

PROJECT TEAM

CLIENT: Auckland Council
DESIGNER: Beca
CONTRACTOR: HEB Construction

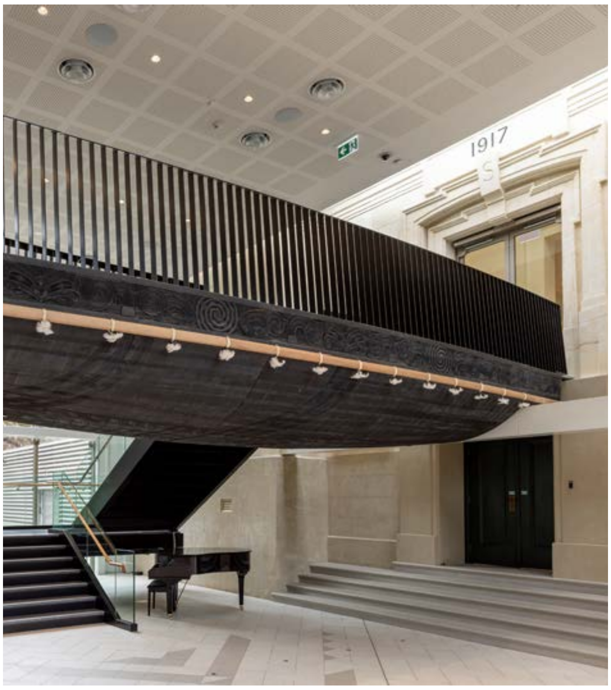
02 WHANGANUI

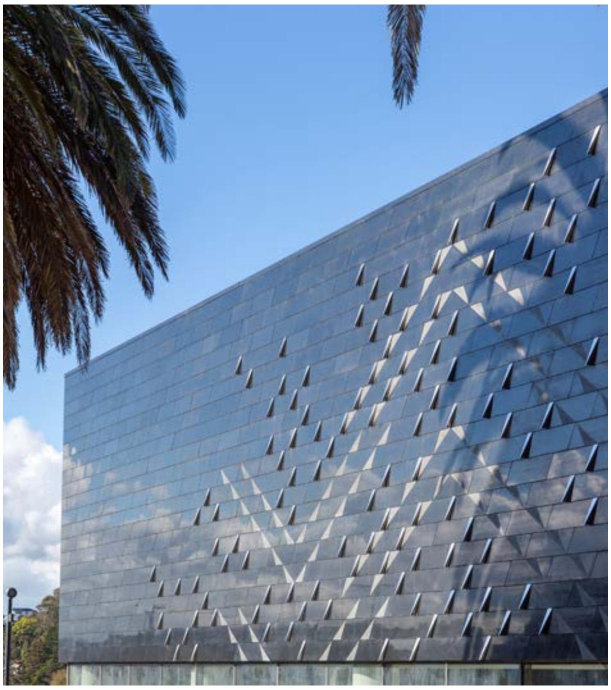
Te Whare o Rehua Sarjeant Gallery

PROJECT OVERVIEW

Te Whare o Rehua Sarjeant Gallery is one of New Zealand's most significant heritage-listed buildings and among the country's oldest purpose-built art galleries. Located in Pukenamu Queen's Park, Whanganui, the gallery opened in 1919 and is recognised for its neo-classical Greek-cross form and Oamaru stone cladding. The gallery houses a nationally important collection of more than 9,000 works spanning 400 years of international and Aotearoa New Zealand art.

In 2014 the building was closed after being assessed as earthquake-prone. A comprehensive redevelopment programme was subsequently undertaken to restore the gallery as a functioning cultural institution while preserving its architectural and heritage value. The project was delivered in two stages: Stage One provided new gallery space and modern archival and curatorial facilities within an expanded basement, while Stage Two focused on seismic strengthening and conservation of the original structure.





Concrete and structural approach

The strengthening strategy combined contemporary concrete technologies with the existing 100-year-old structure to deliver improved seismic performance while remaining visually unobtrusive. Extensive geotechnical investigations were undertaken to assess liquefaction and lateral spread risks. Foundation strengthening included new footings stitched to the existing concrete basement walls, forming a structural skin, along with reinforced concrete tie beams supporting the gallery-level diaphragm floor slab.

Key superstructure interventions included the installation of more than 300 stainless steel post-tensioned bars within the masonry walls, anchored into new concrete capping beams and existing foundations. This system provided enhanced in-plane and out-of-plane capacity while minimising visual impact. A new composite floor diaphragm was created using recycled timber boards over a new concrete floor, while reinforced concrete capping slabs and tie beams were constructed around the central dome. Additional steel bracing at roof level provided diaphragm action over the east and west wings.

Construction challenges and discoveries

Construction was undertaken within a constrained heritage and archaeological setting. Underpinning of foundations and staged excavation in confined conditions required innovative construction methodologies. A retained battered excavation enabled construction of the new basement extension, while heritage elements - including the north wall feature - were carefully removed and reinstated at a higher elevation. Localised cracking caused by corroded cast-iron downpipes was repaired as part of the works.

During coring for the post-tensioned bars, the construction team uncovered a time capsule embedded within the walls. The capsule contained historic news-papers, photographs, original drawings and a letter from benefactor Henry Sarjeant outlining his vision for the gallery, providing a tangible link between the original construction and the contemporary restoration.

Outcomes and significance

The completed project delivers a discreet yet robust seismic upgrade, returning the Sarjeant Gallery to public use as a resilient, world-class cultural facility. Reopened in 2024, the gallery stands as an example of how concrete can be used to strengthen and extend the life of heritage structures while respecting architectural integrity and cultural significance.

PROJECT TEAM

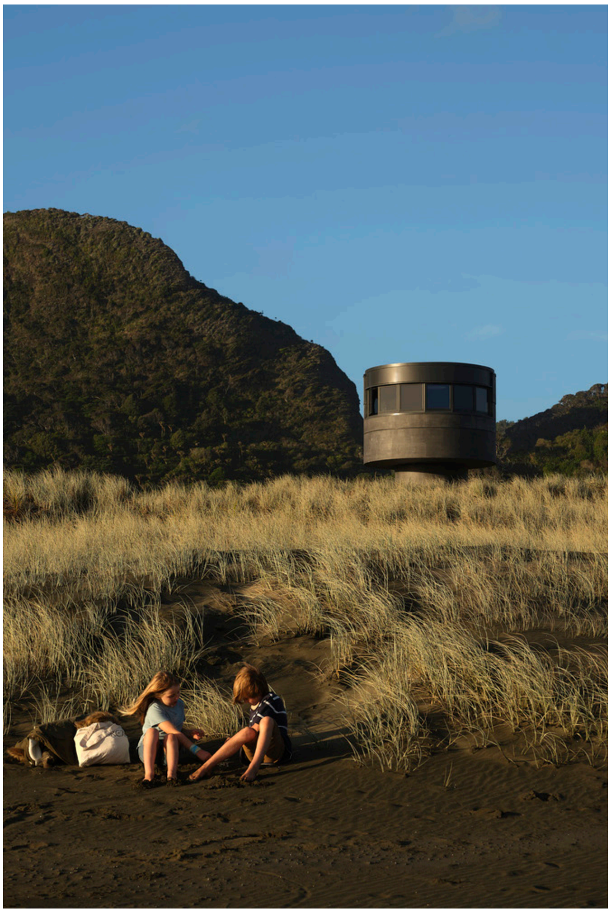
ARCHITECT: Warren & Mahoney
CONSULTING ENGINEER: Clendon Burns & Park
CONTRACTOR: McMillan & Lockwood + Contech

Te Pae North Piha Surf Life-Saving Tower

PROJECT OVERVIEW

Te Pae is a purpose-built surf life-saving tower at North Piha, one of New Zealand's most iconic and hazardous surf beaches. The tower provides essential facilities for observation, patrol and protection, replacing an ageing structure with a durable, low-maintenance building suited to an exposed coastal environment.

The brief required a functional facility for lifeguards with excellent beach visibility, while responding sensitively to the powerful landscape of Piha's black sand beach and dune system.



Concrete and structural approach

Precast concrete was selected early in the design process to minimise on-site construction in a remote and environmentally sensitive location. The structure comprises 10 bespoke precast concrete elements, including six cylindrical shaft elements and three larger podium elements that cantilever toward the sea. These elements sit on a substantial in-situ concrete foundation and support a spiral steel staircase providing access to the observation level.

Black oxide concrete was used to reference the local sand and volcanic landscape, while the curved form reflects the surrounding dunes. Concrete was chosen for its durability, resistance to corrosion and ability to express the building's sculptural intent.

Fabrication and construction challenges

Fabrication required extensive coordination between the design and precast teams. Existing pipe and riser moulds were customised for each element, incorporating openings, cast-in inserts and ducts to support the cantilevered podium and integrated services. Tight quality control was required to manage geometry, reinforcement congestion, lifting points and transport bracing.

Delivery and erection presented logistical challenges, with large-diameter precast elements transported along narrow, winding west coast roads before installation on-site.

Outcomes and significance

Te Pae delivers a robust and enduring coastal structure that supports public safety while responding thoughtfully to place and cultural narrative. It demonstrates the versatility of precast concrete in remote, rugged environments, and its ability to combine durability with architectural expression.

PROJECT TEAM

ARCHITECT: Crosson Architects
CONSULTING ENGINEER: BGT Structures
CONTRACTOR: Scarborough Construction
MATERIAL SUPPLY: Hynds Pipe Systems


Images: Waimea Water

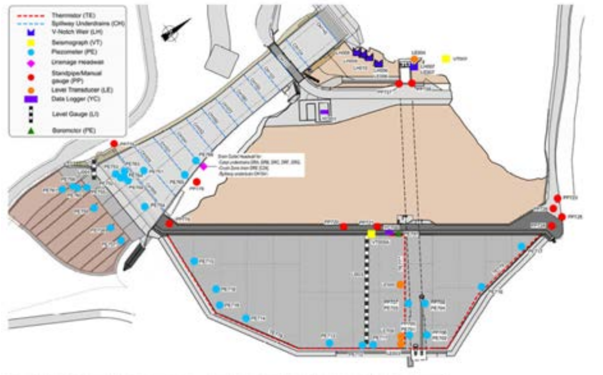
04 TASMAN DISTRICT

Waimea Community Dam

PROJECT OVERVIEW

The Waimea Community Dam is the largest dam constructed in New Zealand in more than two decades and represents a critical investment in long-term water security for the Tasman District. Located in the remote Lee Valley at the top of the South Island, the project has been designed to provide reliable water supply for at least the next 100 years. The scale of the works, isolated alpine setting, steep terrain, and highly variable ground conditions created significant engineering, materials and construction challenges.

The dam adopts a Concrete Face Rockfill Dam (CFRD) configuration, where the entire upstream face comprises reinforced concrete slabs forming the primary waterproofing system. In addition to the embankment, the project includes a number of technically demanding concrete structures, including diversion and outlet works, plinth and grout curtain interfaces, a major spillway system, concrete face slabs and a precast parapet wall.



Throughout the dam structure there are numerous instruments that remotely monitor seepage and seismic movement

Concrete and structural approach

Concrete was selected as a primary construction material due to its durability, strength and suitability for long-life water-retaining structures. A wide range of concrete mixes were developed, ranging from low-strength site kerb concrete through to high-performance structural and self-compacting concretes. Fly ash was widely incorporated to enhance durability, manage heat of hydration, and reduce embodied carbon.

Key structural elements included the diversion culvert, plinth, concrete face slabs and spillway. The diversion structure, a heavily reinforced twin-barrel culvert with sections up to 1.6 metres thick, required high-quality vibration-compacted concrete and precise control of formwork pressures. The Plinth, acting as both waterproofing interface and structural beam, was cast using bespoke adjustable steel formwork to accommodate changing geometric profiles.

Concrete Face construction involved both jump-forming and slipforming methodologies. Starter slabs were cast on steep slopes to establish geometry for subsequent slipformed facing slabs, some extending up to 80 metres in length and requiring pours exceeding 50 hours.

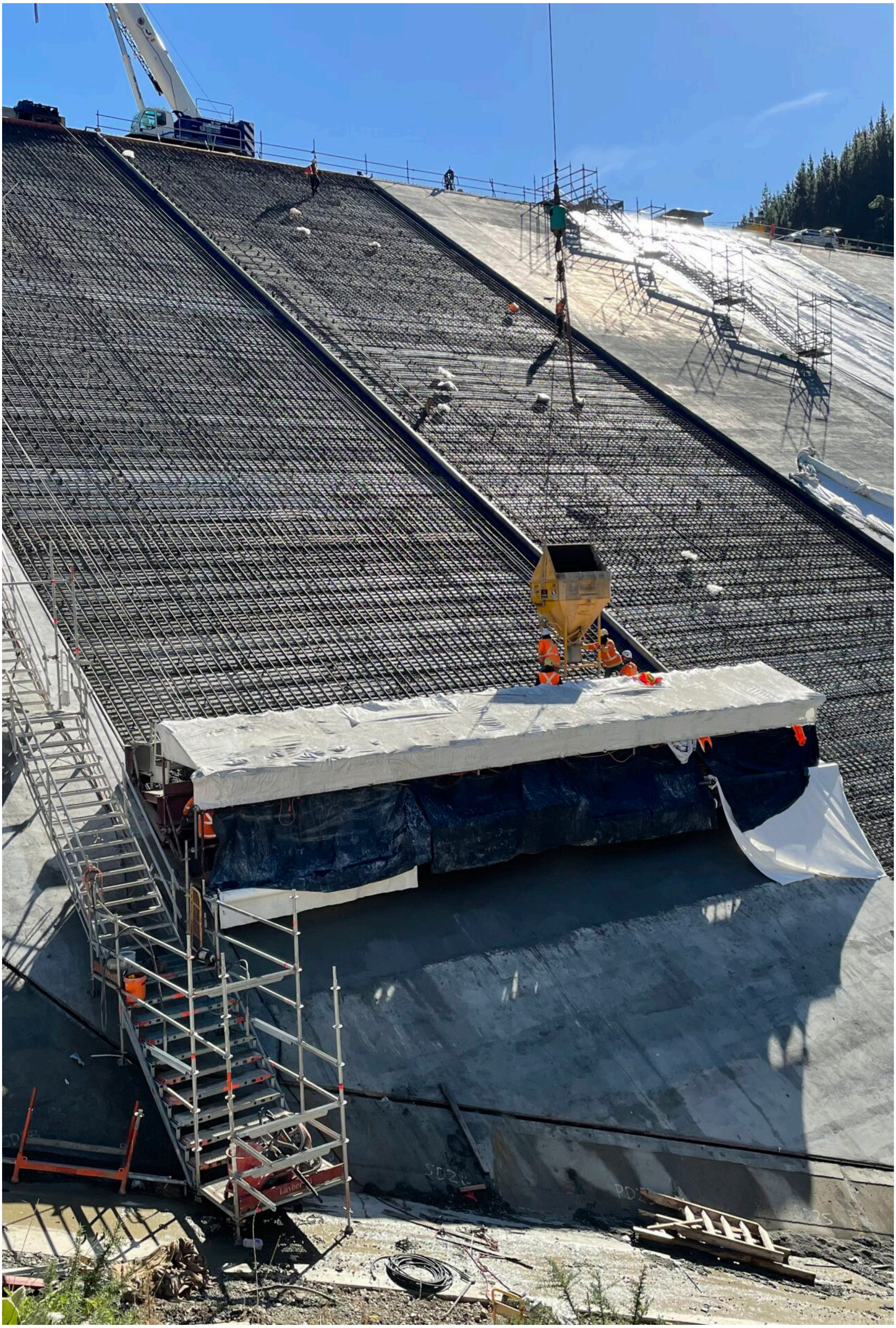
The Spillway, comprising ogee weir, chute, flip bucket, and cut-off wall, demanded exceptional finish quality and tight tolerances to safely manage high-velocity flows and uplift forces.

Construction challenges and responses

Extremely poor rock quality encountered across the site necessitated extensive defect treatment. Remediation measures included slush grouting, targeted hand-excavated concrete pours, shotcrete stabilisation, and mass concrete replacement where required. Preparing rock surfaces proved time-consuming, particularly where shattered rock and clay seams were present.

A variety of placement techniques were employed to address access and geometric constraints. These included tremie concrete placement, long-distance line pumping (up to 200 metres), crane-and-skip delivery for steep slipform operations, and a helicopter-assisted pour for a remote hilltop repeater station foundation.

Slipforming represented the most technically demanding construction methodology. Three distinct slipforming systems were used across the project to achieve specified finishes on steep, curved, and vertical surfaces.



Achieving F6 finishes on 35-degree slopes and double-curved ogee geometries required specialist equipment, rigorous mix design optimisation, and close coordination between construction and materials teams.

Recognising the technical complexity, the project team engaged international slipforming specialists. Brazilian supplier Formas Deslizantes provided equipment and training under challenging COVID-19 conditions, while DESCON engineers supported slipform set-up and methodology refinement. Through iterative adjustments to placement techniques and admixture strategies, productivity rates increased substantially, enabling programme milestones to be achieved.

Outcomes and significance

The Waimea Community Dam demonstrates New Zealand's capability to deliver large-scale, technically complex concrete infrastructure under demanding environmental and logistical conditions.

The project highlights the versatility of concrete in water-retaining structures, the integration of advanced forming technologies, and the value of international collaboration in achieving high-quality outcomes.

The successful use of multiple concrete placement methodologies, combined with extensive defect treatment and stringent finish requirements, underscores the project's technical sophistication. The dam now stands as a resilient, durable, and strategically significant piece of infrastructure supporting regional growth and long-term resource security.

Reference: Loach, M. and Brazzale, N. (2023). *Waimea Community Dam – An International A air.* Concrete NZ Conference. Hamilton, New Zealand.

PROJECT TEAM

CONSULTING ENGINEER: Damwatch Engineering
CONTRACTOR: Fulton Hogan + Taylors Contracting
CONCRETE SUPPLY: Allied Concrete

Images: David St George Photography

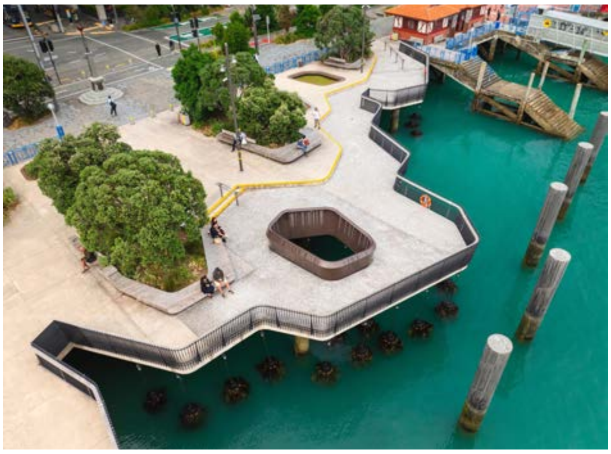
05 AUCKLAND

Te Wānanga, Quay Street Waterfront

PROJECT OVERVIEW

Te Wānanga is a new public waterfront structure on Quay Street, developed as part of Auckland's Downtown Infrastructure Development Programme. The project creates an elevated public space that strengthens the connection between the city and the Waitematā Harbour, incorporating coastal planting, suspended nets and openings that allow visual and physical engagement with the marine environment.

The structure comprises an approximately 1,600 m² suspended reinforced concrete wharf deck with an organic seaward edge and a series of irregular apertures accommodating architectural and ecological features.




Concrete and structural approach

The deck is supported on reinforced concrete-filled steel tube piles and constructed as a heavily reinforced concrete slab with a constant soffit level and variable top surface, resulting in thicknesses ranging from approximately 500 mm to 1,000 mm. Steel planters supporting large pōhutukawa trees are cast integrally into the slab using headed stud connections.

Concrete mix design was central to the project's architectural expression, with a high shell-content mix and varied surface finishes developed to evoke eroded sandstone shelves and reference Auckland's shoreline.

Design methodology and construction

The project was delivered using an Early Contractor Involvement (ECI) model, enabling constructability improvements without compromising architectural intent. Structural analysis employed non-linear modelling and pushover analysis to address seismic performance, soil–structure interaction and long-term durability in a marine environment.

Construction was challenging due to irregular geometry, dense reinforcement, and a constrained inner-city site. Shrinkage and temperature effects governed much of the slab design, requiring careful sequencing, testing, and detailing to control cracking and maintain durability.

Outcomes and significance

Te Wānanga demonstrates the role of reinforced concrete in delivering complex civic infrastructure that integrates structure, landscape and public experience. The project highlights collaborative delivery and performance-based design in a demanding marine context.

PROJECT TEAM

ARCHITECT: Isthmus Group
CONSULTING ENGINEER: Tonkin + Taylor
CONTRACTOR: HEB Construction

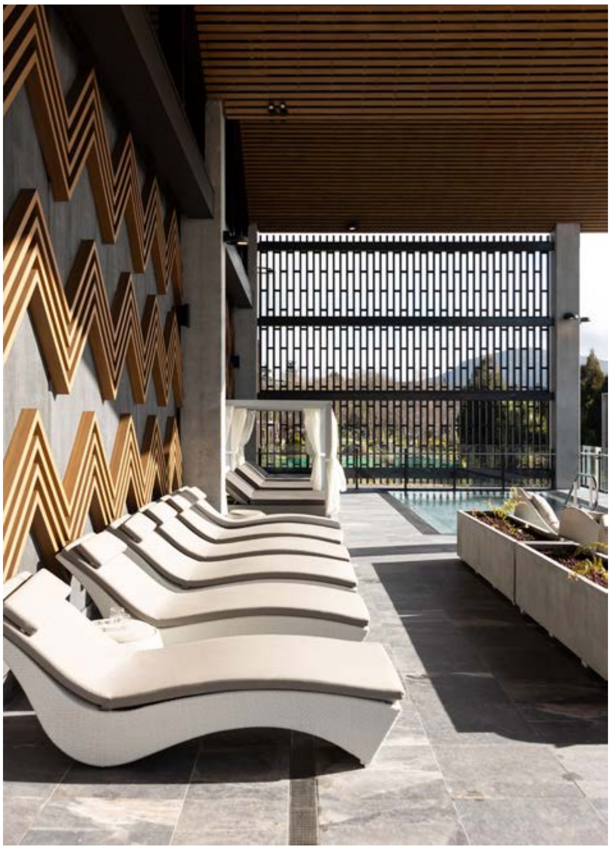
06 ROTORUA

Wai Ariki Hot Springs & Spa

PROJECT OVERVIEW

Wai Ariki Hot Springs & Spa is a luxury wellness facility in Rotorua that celebrates the region's spa heritage and the cultural legacy of Ngāti Whakaue. The brief was to create a facility like no other, developed through the lens of Te Ao Māori - architecturally, experientially and culturally. Māori owned and Māori led, the project embeds authentic cultural narratives while harnessing the area's geothermal resources.

Conceived as a generational asset, Wai Ariki aspires to position Rotorua as a global wellness destination while delivering long-term value for iwi members and the wider community.



Concrete and durability approach

Rotorua's geothermal environment represents one of the most aggressive exposure conditions in New Zealand. Concrete was deliberately selected throughout the complex for its durability, strength and natural aesthetic. The development includes 67 MONARC precast architectural wall panels (approximately 1,038 m^2) and 56 precast square columns, extending up to 9 metres in height, along with extensive in-situ and precast subfloor construction.

Panels and columns were produced using a specially formulated 50 MPa architectural concrete, with durability-enhancing admixtures and high recycled-content reinforcement. Specialist high-performance mixes, including silica fume concrete, were developed to meet sulphate resistance and long-life performance requirements in geothermal conditions.

Architectural expression and construction

Concrete is expressed in multiple finishes, including black oxide board-formed surfaces, diamond-honed and polished panels, ribbed textures and complex patterned F6 panels. Extensive mock-ups and collaboration between architect, contractor and precaster were required to refine finishes and detailing. Roof-supporting columns demanded bespoke moulds and careful coordination of congested reinforcement and integrated services.

Outcomes and significance

Despite stringent durability requirements, the project achieved meaningful reductions in embodied carbon relative to baseline benchmarks. Geothermal water is used for pool heating, underfloor systems and air conditioning, with concrete floors acting as thermal mass to moderate temperatures. Wai Ariki demonstrates how concrete can support cultural expression, architectural ambition and long-term resilience in extreme environments.

PROJECT TEAM

ARCHITECT: RCG Architects
CONSULTING ENGINEER: WSP
CONTRACTOR: Hawkins Construction
LANDSCAPE ARCHITECT: Boffa Miskell
MATERIAL SUPPLIERS: Firth Industries, Nauhria Group and Stevenson Concrete

Images: Adam Mørk Photography

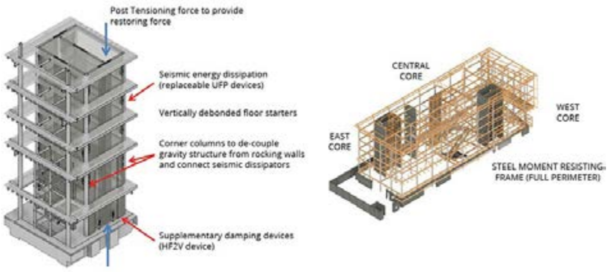
07 CHRISTCHURCH

Tūranga Library

PROJECT OVERVIEW

Tūranga is Christchurch's central library and one of the most significant civic buildings delivered as part of the city's post-earthquake regeneration programme. Located adjacent to Cathedral Square, the five-storey building provides approximately 10,000 m² of floor area and serves as a major public and cultural anchor within the rebuilt central city.

Delivered through a competitive design-build procurement model, the project demanded a structural solution capable of satisfying stringent seismic performance criteria while preserving the architects' design vision, maintaining constructability, and meeting tight budgetary and programme constraints. The structural performance brief extended well beyond conventional life-safety objectives. The building was required to sustain negligible structural damage under frequent seismic events, remain repairable following severe earthquakes, and limit residual displacement to ensure continued functionality and protection of long-term asset value.



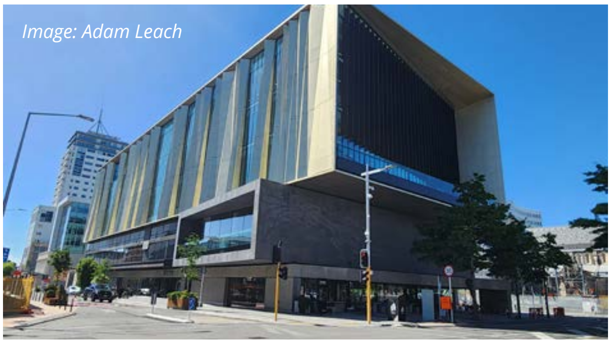


Image: Adam Leach

These requirements reflected Christchurch's post-earthquake context, where resilience, repairability, and rapid post-event recovery were central design drivers. The resulting structural scheme integrates modern low-damage technologies with conventional gravity systems to deliver a highly resilient civic facility.

Concrete and structural approach

A defining feature of Tūranga is its dual seismic resisting system, combining hybrid precast concrete rocking walls within three central cores with perimeter steel moment resisting frames (MRFs). The hybrid concrete wall cores provide approximately 75 percent of the building's seismic resistance, while the perimeter steel frames contribute the remaining lateral capacity and provide critical torsional stiffness.

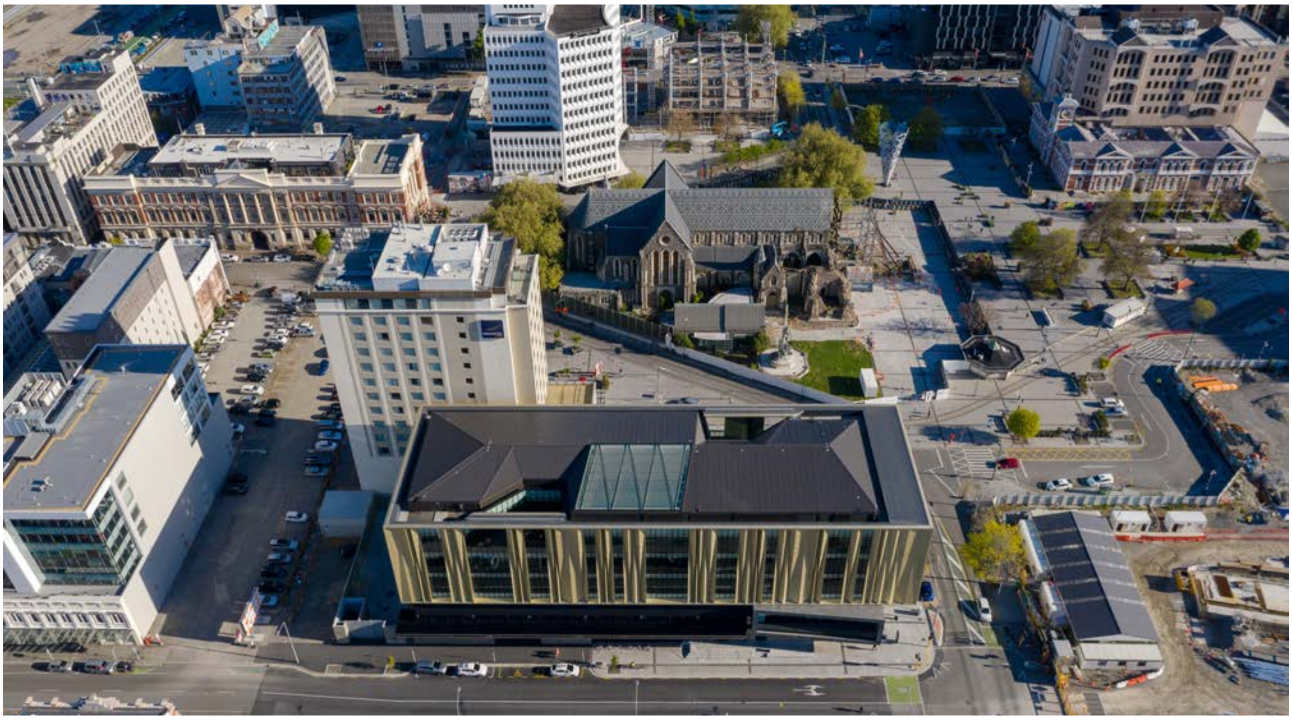
Each hybrid wall incorporates high-strength, unbonded post-tensioned tendons that clamp the walls to their foundations with significant pre-stress forces. During seismic excitation, controlled rocking occurs at the wall bases, allowing the structure to isolate itself from peak accelerations. As the walls uplift and rotate, the elongation of the tendons generates restoring forces that return the building toward its original position, providing inherent self-centring behaviour.

Energy dissipation is achieved through a combination of replaceable mechanisms located at key movement regions. U-shaped flexural plates (UFPs) positioned at wall ends provide stable hysteretic damping, while High force-to-volume lead dampers (HF2V) located at wall bases deliver supplementary energy absorption immediately upon gap opening. This integrated system enables controlled inelastic behaviour while minimising damage to primary structural components.

The column–wall–column configuration adopted for the hybrid walls represents a refined approach to low-damage design. Vertical gravity support is disengaged from wall rocking movements, reducing slab interaction forces and limiting floor damage. Wall-to-slab connections incorporate selective vertical de-bonding in high-movement zones while maintaining conventional bonded reinforcement in lower-movement regions, balancing robustness with damage mitigation.

The gravity load-resisting system comprises concrete-filled tubular composite steel columns, welded steel beams, and long-span floor construction. Floors are formed using bespoke 325 mm deep prestressed precast concrete ribs with timber infills and a 90 mm in-situ concrete topping slab. The rib depth was deliberately increased to optimise vibration performance and reduce temporary propping requirements during construction, improving programme efficiency.


TŪRANGA



Foundations consist of shallow reinforced concrete beams bearing on competent near-surface gravel layers. This solution was enabled by the strategic decision to eliminate a basement and relocate plant facilities to roof level, reducing geotechnical risk, construction complexity, and overall project cost within Christchurch's challenging ground conditions.

Construction and verification

Structural verification followed displacement-based design principles supported by extensive non-linear analytical methods. Pushover and non-linear time-history analyses were undertaken to confirm system compatibility, drift control, residual displacement limits and device performance under a range of return-period seismic events. Non-linear modelling incorporated detailed representations of post-tensioning behaviour, rocking interfaces, energy dissipators and contact mechanisms. Full-scale prototype testing of the HF2V dampers validated design assumptions.

A key construction innovation was the casting of major concrete core wall elements as full-height on-site tilt panels. Several panels exceeded 140 tonnes, representing some of the largest tilt panels constructed internationally. This methodology reduced horizontal joints, accelerated programme delivery, enhanced dimensional accuracy, and provided early-stage structural stability through effective self-bracing.

Outcomes and significance

Tūranga demonstrates the successful integration of advanced low-damage concrete systems within a large-scale civic building in a high seismic zone. The hybrid rocking wall technology, combined with replaceable energy dissipation devices and self-centring behaviour, provides a resilient, repairable structure capable of meeting demanding post-earthquake performance objectives.

The project establishes a benchmark for low-damage seismic design in New Zealand, illustrating how structural performance, architectural freedom, constructability and economic viability can be aligned within a design-build framework. As a major public facility, Tūranga embodies Christchurch's broader resilience narrative, delivering long-term durability, functionality and community value.

Reference: Shannon, T. (2019).*Tūranga Library Christchurch - Hybrid Rocking Precast Concrete Wall Panels.* Concrete NZ Conference, Dunedin, New Zealand.

PROJECT TEAM

ARCHITECT: Architectus (NZ) + Schmidt Hammer Lassen Architects (Denmark)
CONSULTING ENGINEER: Lewis Bradford Consulting Engineers
CONTRACTOR: Southbase Construction

Beaumont Bridge, Clutha River (Mata-Au)

PROJECT OVERVIEW

The Beaumont Bridge replacement project delivers a modern two-lane crossing of the Clutha River (Mata-Au) on State Highway 8, a key transport link connecting Dunedin, Central Otago, and Queenstown. The original single-lane bridge, constructed in 1887, had provided more than a century of service but was no longer suited to contemporary traffic demands, particularly increased volumes and heavier freight vehicles.

The new 195-metre-long bridge, constructed adjacent to the historic structure, provides improved safety, resilience and operational capacity. In a deliberate act of adaptive reuse, the former bridge will remain as a walking and cycling connection, linking to the Clutha Gold Cycle Trail and preserving an important element of regional heritage.

Concrete and structural approach

The bridge adopts a curved composite steel girder superstructure with a reinforced concrete deck, efficiently combining the complementary strengths of steel and concrete. The deck is supported by four reinforced concrete piers founded on large-diameter piles drilled approximately 13–14 metres into competent bedrock beneath the riverbed. A central pier positioned on a prominent rock outcrop presented both structural and construction complexities.

Concrete played a critical role across foundations, substructure and deck works. Tremie concrete was used extensively for permanent and temporary foundations constructed within cofferdams and river diversions. Specialised concrete mixes were developed to meet demanding performance criteria, including freeze–thaw-resistant deck concrete and self-compacting concrete (SCC for barrier pours and stitch joints between precast elements. Pier columns, approximately 7 metres in height and up to 1.7 metres in diameter, transition into larger-diameter piles to provide robust load transfer and durability.

Construction and verification

The remote Otago location imposed significant logistical constraints, with concrete supplied from batch plants in Balclutha and Alexandra, requiring round trips of up to two hours. Maintaining continuity, consistency and workability demanded careful planning, close coordination and extensive testing. Daily SCC barrier pours and critical expansion joint placements required highly stable, repeatable mix performance.

Innovative temporary works solutions were adopted, including soffit support systems that avoided through-column tie rods, improving both constructability and finished surface quality. Flowable SCC mixes enabled defect-free stitching of architectural precast barriers, ensuring high-quality visible finishes.

Outcomes and significance

The Beaumont Bridge exemplifies the role of concrete in delivering durable, resilient infrastructure within challenging environments. The project integrates structural performance, construction innovation and cultural design expression, establishing a visually distinctive landmark while strengthening a vital regional transport corridor.

PROJECT TEAM

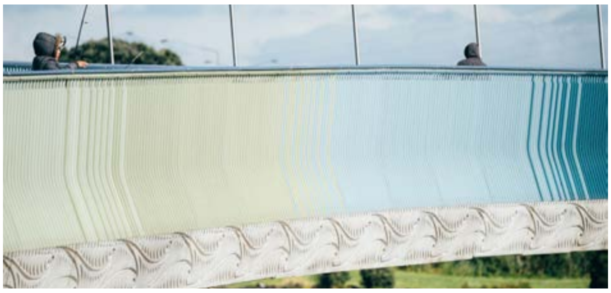
CLIENT: NZ Transport Agency Waka Kotahi
CONSULTING ENGINEER: WSP
CONTRACTOR: HEB Construction
CONCRETE SUPPLY: Allied Concrete
PRECAST ELEMENTS: McIntosh Precast Limited
CULTURAL DESIGN: Aukaha + Kāi Tahu Artists

Ngā Hau Māngere Pedestrian Bridge, Manukau Harbour

PROJECT OVERVIEW

Ngā Hau Māngere Pedestrian Bridge replaces the historic Old Māngere Bridge, which had served as a vital connection between Māngere Bridge Village and Onehunga for more than a century. Commissioned by Waka Kotahi NZ Transport Agency and delivered by McConnell Dowell, the new 260-metre-long bridge provides a contemporary walking and cycling link designed to meet modern safety, durability and community expectations.

Developed in partnership with mana whenua and through collaboration between Aurecon, Bossley Architects and Isthmus Group, the bridge was conceived not only as transport infrastructure but as a civic destination. The intentionally wide deck accommodates pedestrians and cyclists while creating generous spaces for pause, viewing and social interaction within the Manukau Harbour setting.



Concrete and structural approach

The bridge features a curved alignment and a composite structural system centred on a dramatic 60-metre steel-tied arch. Beyond this focal span, the superstructure is predominantly concrete, reflecting the material's durability, mass and adaptability for long-life marine infrastructure.

A user-centred design informed the integration of dedicated fishing bays, achieved through in-situ concrete cantilever decks extending transversely from precast concrete beams. Transverse post-tensioning was employed to distribute loads across the deck and mitigate torsional demands on edge beams, ensuring structural efficiency while supporting community use.

The inclined concrete pier columns supporting the central arch presented significant structural challenges due to the shallow geometry required. Post-tensioned concrete solutions within the piers, combined with external post-tensioning linking pier heads, provided the necessary stiffness and load transfer capacity. Limited geometric space at the arch–pier interface led to the development of an innovative load transfer mechanism using embedded steel plates within concrete elements, replacing conventional corbel solutions.

Durability considerations were central to the specification. Concrete mixes incorporated high levels of cement replacement using ground granulated blast furnace slag to reduce heat of hydration, enhance long-term performance, and lower embodied carbon. Proprietary waterproofing additives further improved resistance to tidal and splash-zone exposure.

Construction challenges and innovations

The tidal marine environment, combined with construction alongside a deteriorated heritage structure, required extensive digital modelling, staging analysis and archaeological oversight. The curved alignment simultaneously acknowledged key volcanic landmarks and enabled construction of the new bridge prior to demolition of the old.

A full 3D modelling workflow supported coordination of geometry, reinforcement and connection tolerances, contributing to efficient construction and early completion.

Outcomes and significance

Ngā Hau Māngere exemplifies the integration of structural concrete, cultural narrative and community-centred design. The bridge functions as both strategic active-transport infrastructure and a lasting public destination, designed to serve future generations while reflecting the cultural and environmental context of Tāmaki Makaurau.

PROJECT TEAM

ARCHITECTS: Bossley Architects + Aurecon
CONSULTING ENGINEER: Aurecon
CONTRACTOR: McConnell Dowell Constructors
LANDSCAPE ARCHITECTS: Isthmus Group

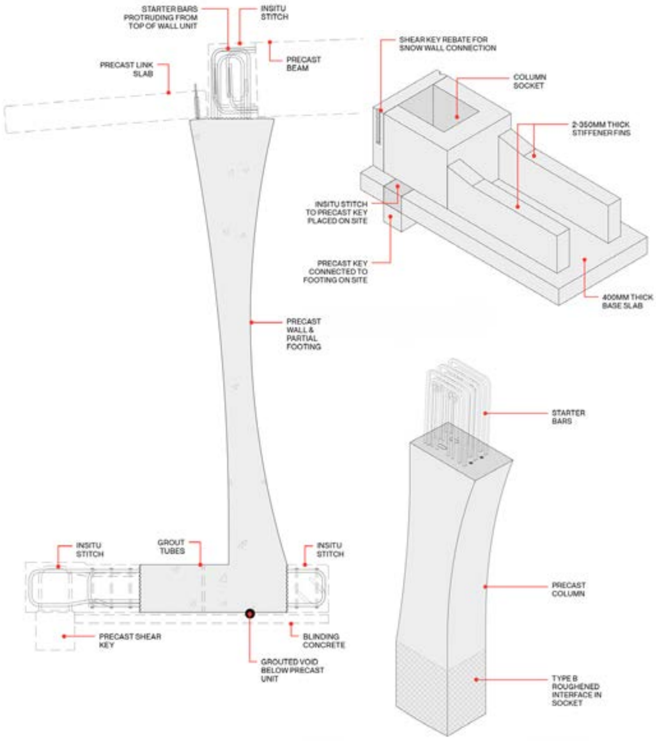
10 FIORDLAND NATIONAL PARK

SH94 Homer Tunnel Avalanche Shelter

PROJECT OVERVIEW

State Highway 94 (Milford Road) is one of New Zealand's most strategically important and visually dramatic alpine highways, providing the only road connection between Te Anau and Milford Sound. At the eastern portal of the Homer Tunnel, the highway passes beneath a steep 600-metre rock bluff, directly exposed to a large and active avalanche zone, frequent rockfall and extreme sub-alpine weather. The original avalanche shelter, constructed decades earlier, had deteriorated to a condition that raised concerns regarding durability, structural robustness and long-term resilience.

NZ Transport Agency Waka Kotahi commissioned the replacement shelter to provide enhanced protection for road users while preserving the engineering heritage and environmental values of Fiordland National Park, a UNESCO World Heritage site. The project demanded a solution capable of resisting extreme avalanche and rockfall loads, very high rainfall (approaching seven metres annually), and significant seismic demands associated with proximity to the Alpine Fault.



Construction was restricted to a six-month window outside the avalanche season and required to proceed without disrupting peak tourism traffic. The remote site, located approximately 900 metres above sea level and 90 minutes from Te Anau, imposed additional logistical, safety and programme constraints.

Concrete and structural approach

The replacement shelter comprises a 45-metre-long reinforced concrete portal frame structure designed to withstand exceptional impact and lateral loading demands. A defining feature of the design is the incorporation of a sacrificial earth embankment along the upslope side. This engineered deflection system redirects avalanche flows up and over the shelter, significantly reducing direct impact forces and making a structurally feasible solution achievable at a site characterised by extreme avalanche risk.

Concrete was selected as the primary construction material due to its inherent mass, durability and robustness under impact loading. The portal frames, walls, and columns provide resistance to avalanche pressures, debris impact, rockfall and seismic forces. The downstream side of the shelter adopts an open configuration supported on reinforced concrete columns, maintaining tunnel ventilation, driver sightlines and emergency egress provisions.

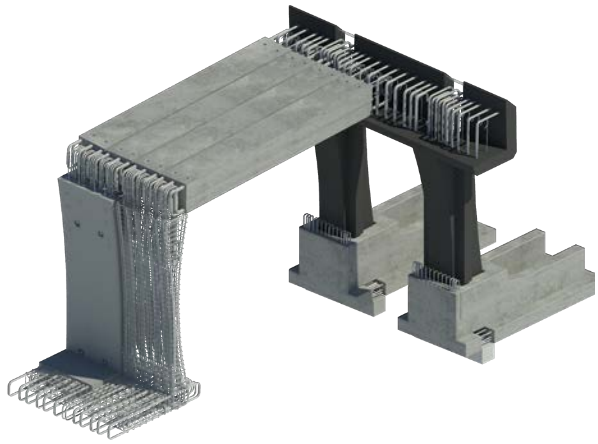
The structural design also addressed demanding serviceability requirements, including crack control, durability under freeze–thaw cycles and long-term performance in a highly aggressive wet alpine environment. Fibre reinforcement was incorporated into selected concrete elements to enhance impact resistance and mitigate spalling risks associated with snow clearing operations and maintenance activities.

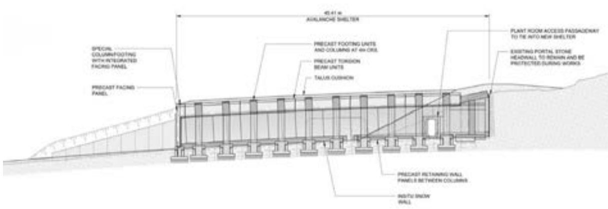
Construction challenges and innovations

Programme certainty governed all aspects of design and delivery. With construction limited to the non-avalanche season, the project operated under a fixed and immovable deadline. Accelerated construction methodologies based on extensive use of precast concrete elements became central to the project's success.

The shelter incorporates approximately 160 individual precast elements, fabricated off-site to maximise quality control and minimise construction duration at the hazardous alpine location. Innovative connection details were developed to provide generous construction tolerances, recognising that misalignment or fit-up issues could not be accommodated within the compressed programme. These connections enabled rapid assembly while maintaining structural integrity and durability performance.

A guiding principle of the project was to "minimise time on site." The design favoured self-supporting precast





units, simple stitch pours and detailing that reduced the need for complex formwork, falsework and site-installed reinforcement. Connections were engineered to allow continued progress without waiting for full in-situ concrete strength gain on critical path activities. Temporary works requirements were correspondingly reduced, with only limited propping and light scaffolding required for access and safety.

Given the geometric complexity and architectural treatments, many precast components required multi-stage pours, specialised moulds and carefully engineered lifting, rotation and transport strategies. Digital modelling proved indispensable. A full 3D model of the shelter was developed using Revit, with Navisworks employed for clash detection and coordination. This approach ensured compatibility of reinforcement cages, starter bar layouts, connection details and architectural features, significantly reducing fabrication and construction risk.

Concrete treatments and architectural response

Resource consent conditions placed strong emphasis on visual integration within the surrounding alpine landscape and recognition of the Homer Tunnel's engineering heritage. Concrete finishes and treatments were therefore integral to the design.

External concrete elements incorporated black oxide pigmentation, producing a darkened tone that visually recedes against the adjacent rock bluff and talus slopes. Internal concrete surfaces were left un-tinted to maximise reflectance of natural light, reducing the perceptual "dark hole" effect at the shelter entrance. Curved profiles in walls and columns echo the geometry of the historic stone tunnel portal, reinforcing continuity between the new intervention and the heritage structure.

Cultural engagement with mana whenua informed the integration of vapour-blasted artwork at the shelter entrance. These treatments were incorporated into precast fascia panels requiring specialised casting and lifting solutions. Waterproofing additives, including self-healing technologies, were specified in selected elements due to the impracticality of conventional site-applied membranes under Fiordland's extreme rainfall and abrasion conditions.

Outcomes and significance

The SH94 Homer Tunnel Avalanche Shelter represents a highly successful integration of structural engineering, construction innovation, durability design and landscape-sensitive architecture. Delivered within programme and budget, the shelter now provides robust long-term protection against avalanche and rockfall hazards while maintaining uninterrupted operation of a nationally significant transport corridor.

The project demonstrates the critical role of concrete in extreme alpine environments, highlighting the material's capacity to deliver resilience, durability, constructability and architectural expression under some of New Zealand's most demanding natural conditions.

PROJECT TEAM

CLIENT: NZ Transport Agency Waka Kotahi
CONSULTING ENGINEER: WSP
CONTRACTOR: HEB Construction
PRECAST CONCRETE: McIntosh Precast Limited
CULTURAL DESIGN + ARTWORK: Aukaha + Mana Whenua Artists

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